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THE RELATIONSHIP OF K-VALUES TO PROBABILITY OF SHOWERS IN THE MID-SOUTH

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ABSTRACT

This article describes and illustrates a forecasting technique used at Memphis for shower and thundershower potential for a given day during the summer months over the Mid-South agricultural area. This technique is related to the precipitation probability now currently used by the ESSA Weather Bureau. The statistical analysis used in this development is shown.

INTRODUCTION

Accurate forecasting of showers and thundershowers from late spring until early fall is one of the most important services for the Mid-South agricultural program; however, achieving a high degree of accuracy is a very significant problem. Air mass thundershowers, as well as occasional frontal showers and thundershowers, occur during this time with air mass activity usually playing the dominant role.

In the absence of early machine prog analysis, K-values have proved to be a very quick and useful tool. We concede that the machine can organize data more quickly and consider more factors, but the K-values have considerable merit. The K-chart is a factor to analyze in conjunction with other information, but overall it gives one a better idea where to look and a little better visual analysis.

PROCEDURE OF INVESTIGATION

The forecast problem was defined as: What percent of the Mid-South agricultural area including the Missouri Bootheel, West Tennessee, Northern Half of Mississippi, Louisiana Delta, and Arkansas will receive measurable rain during the 24-hour period following the 1200Z observational data? (See Fig. 1)

Rainfall records from 75 reporting stations connected by the agricultural and public service communications network over the Mid-South were used to determine a percent probability of these stations receiving measurable rain during this 24-hour period.

K-values, as described by J. J. George, combine both moisture and stability parameters into a single, easily computed index. (See Fig. 2) These values can be computed for the areas east of the Rocky Mountains in approximately 10 minutes. Wind data at 700 MB is also plotted for advection information. The chart is then analyzed by drawing K-value isopleths with intervals of five units. (Refer to Fig. 3) Rainfall for the following 24-hour period is shown in the lower right hand corner of the figure. This simple K-chart has proved very useful in the agricultural program as well as the state and aviation forecast programs, and has led to this attempt to objectively relate K-values to the point probability of showers and thundershowers. A Chi-Square analysis shows statistical significance at the 99 percent confidence level between increments of rainfall amount and K-value amount.

Figure 4 shows a breakdown of total cases of measurable rainfall for 75 stations in the Mid-South for the summer months from May through September distinguishing them from precipitation amounts and K-values. Figure 5 portrays the graphical picture showing percent of total of each K-value for various increments of precipitation amounts. Here it is seen that there are more cases of measurable precipitation with increasing K-values.

By taking a portion of cases and graphically portraying them, it is found with precipitation values between .50 and 1.99 inches of rain that the percent of total cases more than doubles when equal or greater than 30K is used and that there is slightly over 90 percent of total cases when equal or greater than 20K is used. (See Figure 6A) When using one-quarter inch or more rain in comparison with .50 to 1.99 inches the percent of total cases increases slightly for equal or greater than 30K and also for equal or greater than 20K. (Refer to Figure 6B) A total of 10,857 cases of rain and no rain was used in this study, 4441 of no rain cases with less than 20K, 2602 cases of no rain with 20-29K, and 1390 cases of no rain with 30K or greater.

Figure 6C shows the probability of rain for any particular station over the Mid-South. Cases with rain over total cases (rain and no rain) give the percent probability rounded to the nearest increment of 10. As would be expected, the higher the K-value the greater the probability. It is also found that 4 percent probability of rain or 96 percent probability of no rain is noted for cases less than 20K. Of course 4 percent rounded to the nearest increment of 10 is zero.

SUMMARY AND CONCLUSIONS

A definite relationship of K-values to shower and thundershower occurence has been established in the Mid-South. This addition of K-values as a tool in forecasting point probability of showers and thundershowers has definitely improved this type of forecast to the extent that all users contacted express satisfaction with this service. Not only does this study work well with air mass activity but also can be applied with good accuracy to approaching cold fronts.

The main advantage of this technique is that it can be prepared early around 7 a.m., some two hours before remaining raob data and computer progs are received.

ACKNOWLEDGMENT

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2. Jack Hollis and Kenneth E. Bryan, "The Relationship of K-Values to Areal Coverage of Showers in the Mid-South", Technical Memorandum No. 2, August 1965.

WBAS MEMPHIS AREA FOR WHICH AGRICULTURAL FORECASTS ARE ISSUED

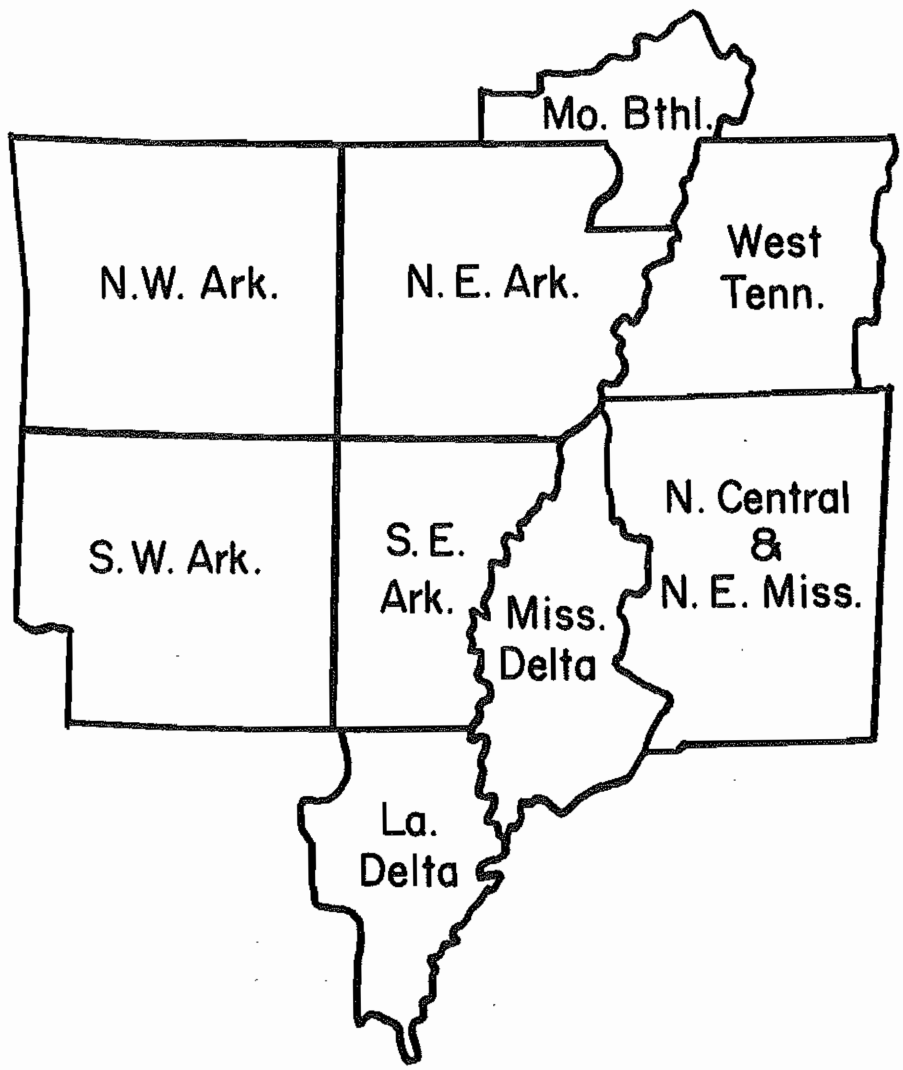

FIGURE 1

K = (850 MB Temp. + Dewpoint) – (700 MB Spread) – (500 MB Temp.)

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UXUS 3Ø 3Ø125Ø

FTW
GSW GW TT 72259 12 1Ø196 85569 2ØØ82 Ø27Ø6 7Ø2Ø1 Ø5523 Ø1Ø16     = 30K
5Ø589 588Ø7 ØØ9Ø3 Ø2Ø
LIT TT 7234Ø 12 1Ø196 85558 195Ø2 Ø35Ø6 7Ø195 Ø6Ø14 ØØ212 5Ø588 = 20K
57797 Ø3Ø13 Ø9Ø
SHV TT 72248 12 1Ø196 85553 17518 ØØ113 7Ø183 Ø8662 ØØ1Ø6 5Ø587
59839 Ø34Ø4 Ø8Ø
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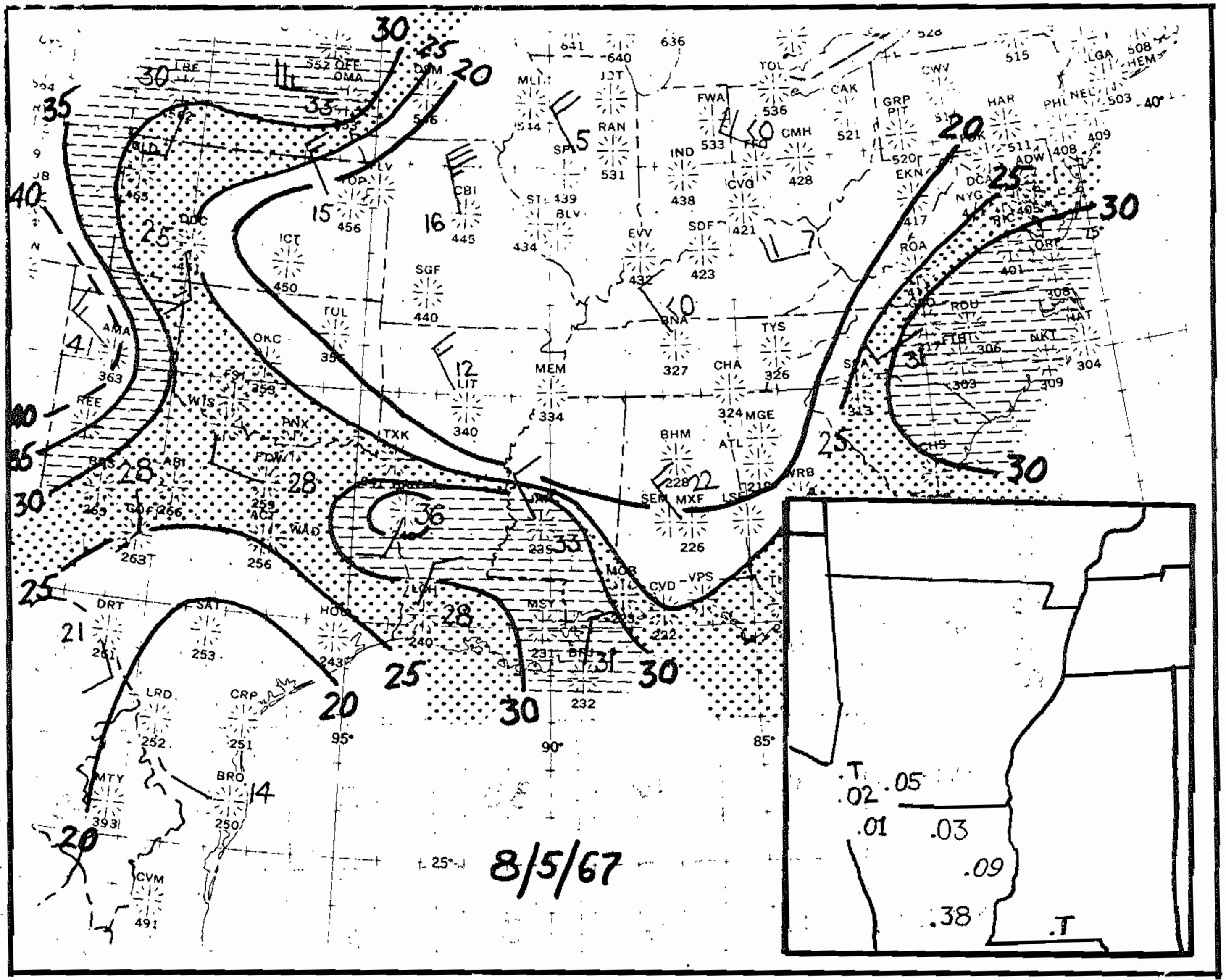
FIGURE 2



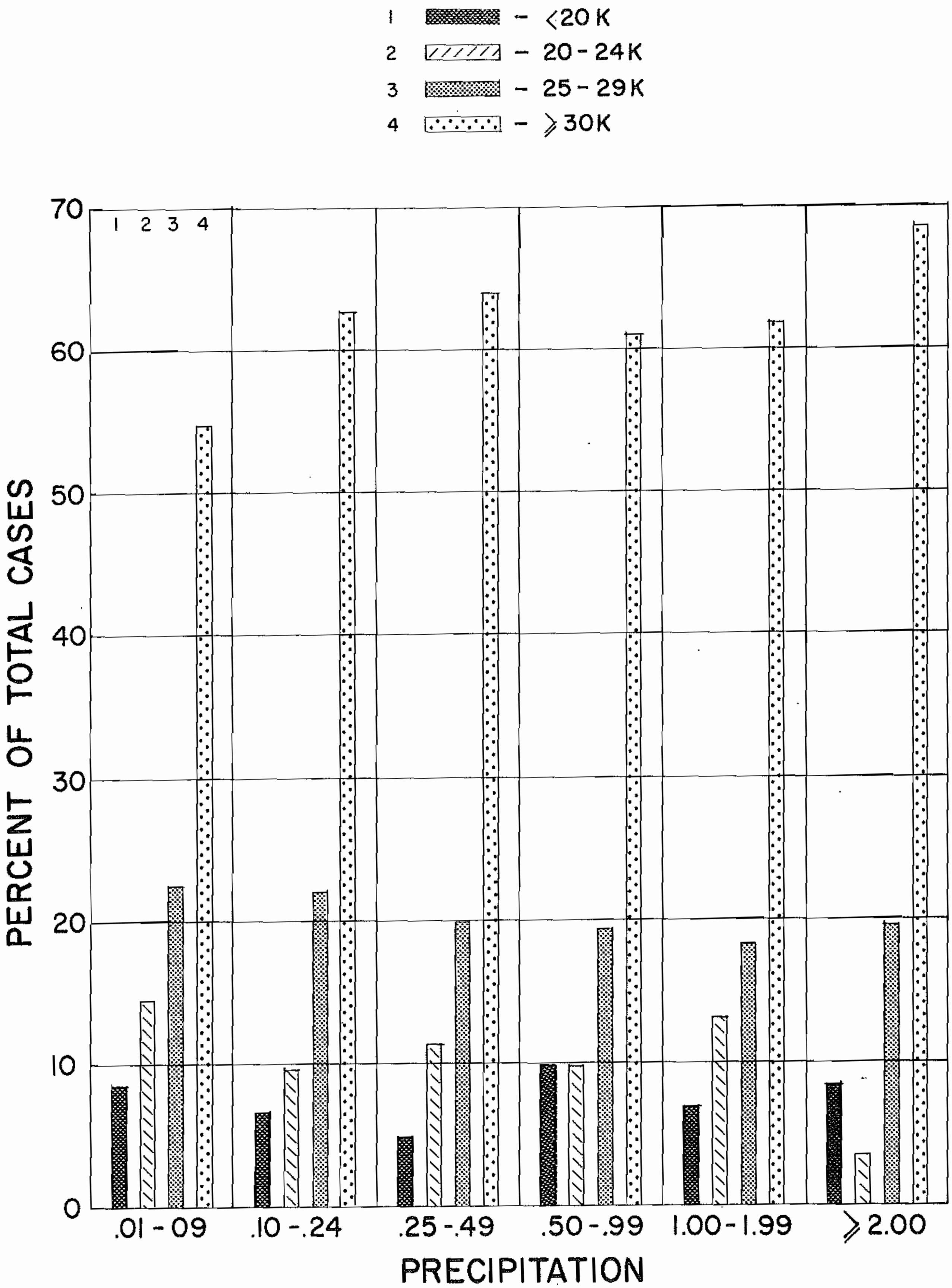
K-CHART AND FOLLOWING 24 HR. RAINFALL
FIGURE 3

K VALUES

PRECIPITATION	≤ 14	15 - 19	20 - 24	25 - 29	30 - 34	35 & >
.01 - .09	37	27	108	167	276	134
.10 - .24	15	18	47	110	211	102
.25 - .49	9	15	54	97	174	134
.50 - .99	18	26	43	87	162	108
1.00 - .199	5	12	33	46	85	69
≥ 2.00	0	5	3	13	20	25

CASES

FIGURE 4



1 - <20 K
2 - 20 - 24K
3 - 25 - 29K
4 - ≥30K
70
60
50
40
30
20
10
0
1 2 3 4
PERCENT OF TOTAL CASES
.01 - 09
.10 - .24
.25 - .49
.50 - .99
1.00 - 1.99
≥2.00
PRECIPITATION

FIGURE 5

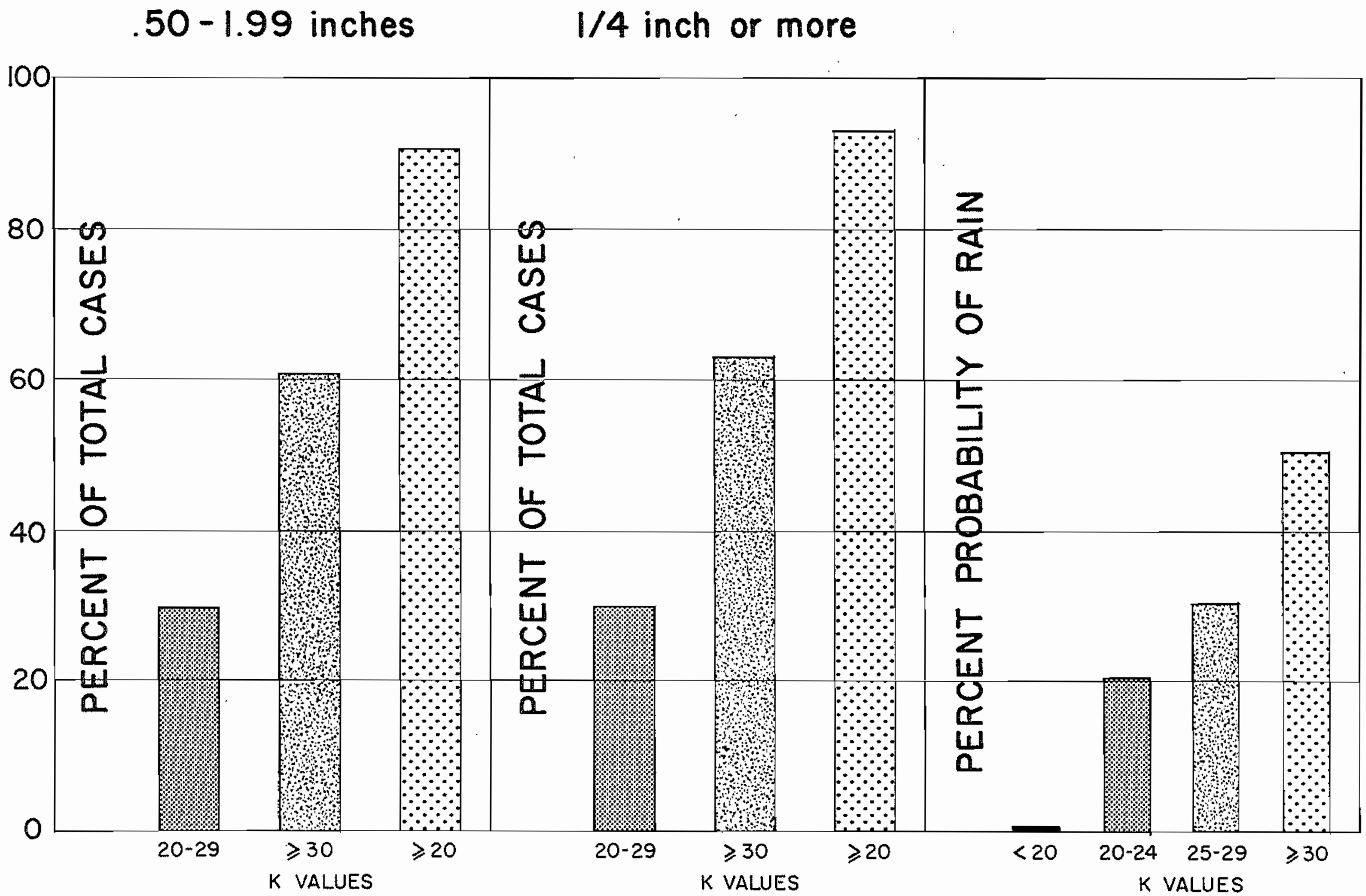


FIGURE 6A

FIGURE 6B

FIGURE 6C

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